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U.S. SEARCH AND RESCUE
MISSION CONTROL CENTER FUNCTIONS

Final Report

December 15, 1977

Prepared for

National Aeronautics and Space Administration
Washington, D.C. 20546

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SECTION 1. INTRODUCTION



SECTION 1. INTRODUCTION

Background information concerning satellite-aided Search and Rescue (SAR) can be found in references 1 and 2. Briefly, the baseline satellite-aided SAR Mission concept consists of two systems: (1) the local coverage bent-pipe system, and (2) the global coverage system.

In the bent-pipe system, Emergency Locator Transmitter (ELT)/Emergency Position Indicating Radio Beacon (EPIRB) transmissions on 121.5/243 and 406 MHz are relayed to a Local User Terminal (LUT) in real-time whenever there is mutual spacecraft visibility by an ELT/EPIRB and LUT. Three LUT's can provide full coverage for the continental United States, Alaska, adjacent maritime regions, and large portions of the Atlantic and Pacific Oceans.

In the global coverage system, 406 MHz transmissions from a new generation of ELT/EPIRB's will be processed by the SAR instrument onboard a TIROS spacecraft. This on-board processing will consist of receiving, detecting, identifying, and measuring the frequency of the 406 MHz ELT/EPIRB transmissions. The processed data will be input to the Manipulated Information Rate Processor (MIRP), which will insert this data Global Area Coverage (GAC) frames for tape recording (see section 2.1). Note that this processed data is also downlinked in real-time to the LUT's, but only when there is mutual visibility.

The SAR 406 MHz incident data thus recorded will provide full global coverage. These data will be dumped whenever the TIROS spacecraft is over one of its two ground stations. A functional organization within the SAR mission is required to receive this dumped data in order to use them to compute the position of ELT/EPIRB transmissions. The functional organization will be the U.S. SAR Mission Control Center (USMCC).



The United States and Canada will each have a Search and Rescue Mission Control Center (MCC).

The primary functions of the United States (USMCC) are as follows:

- a. Receive and process 406 MHz stored data and forward the received data to the Canadian MCC (see section 2.1).
- b. Forward position locations based upon stored 406 MHz data to the appropriate Rescue Coordination Centers (RCC's) (see section 2.1).
- c. Receive ephemeris data from the National Oceanographic and Atmospheric Administration (NOAA) and distribute them to the Canadian MCC, the U.S. Local User Terminals, and to any other country/agency requiring them (see section 2.2).
- d. Receive recorded TIROS Information Processor (TIP) data that is relative to the SAR instrument (see section 2.3).
- e. Serve as the single point of contact for communications to NOAA; in particular, provide and coordinate commands to be relayed by the TIROS-N Spacecraft Operations Control Center (SOCC) to the SAR instrument (see section 2.4) and resolve schedule conflicts (see section 2.5).
- f. Receive acquisition (of spacecraft signal) schedules from NOAA, and forward this information to Canada's MCC and the U.S. LUT's (see section 2.6).
- g. Collect a data base in order to evaluate the effectiveness of satellite-aided Search and Rescue system (see section 2.7).
- h. Ensure uniform software development and other coordination among the U.S. LUT's, and coordination with Canada (see section 2.8).



- i. Together with the Canadian MCC, provide general, and any other, coordination of the satellite aspects of satellite-aided Search and Rescue.

The SAR instrument will consist of a Canadian repeater and a French processor for which Canada and France, respectively, will evaluate health and trends.

Section 2 of this document examines MCC functions in greater detail. Section 3 is a summary of the interface requirements necessary to perform each function, whereas section 4 summarizes the information requirements between the USMCC and each of its interfaces. Section 5 discusses the physical requirements (i.e., location, manning, etc.) of the USMCC.



SECTION 2. MISSION CONTROL FUNCTIONS



SECTION 2. MISSION CONTROL FUNCTIONS

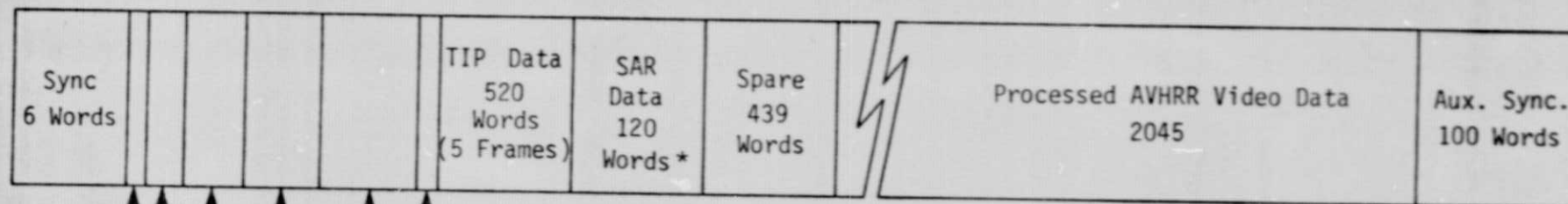
This section develops the Mission Control functions enumerated in Section 1.

2.1 SAR INCIDENT DATA

The SAR instrument will output processed 406 MHz SAR incident data into the TIROS GAC formatter at the rate of 1200 bits per GAC frame. This results in a bit rate of 2400 bits/sec. (Note that the data-flow is also sent to the Canadian repeater with a biphase level coding.) The GAC frame format is given in figure 2-1. GAC data are tape recorded and dumped when the TIROS spacecraft is over a TIROS ground station. The dumped data are first transmitted to the TIROS SOCC in Suitland, Maryland. The data are then relayed to the National Environmental Satellite Services (NESS's) Data Processing and Services Subsystem (DPSS) in Suitland, Maryland, for processing. In this section, SAR incident data refer to the 406 MHz tape recorded data.

SAR incident data will be formatted by the SAR processor into data messages. Each of these messages consists of eight 24-bit words originating from a single Data Recovery Unit (DRU). The format for these messages is given in figure 2-2. In the event of multiple data messages, the eight words of DRU 1's data message may be interleaved with the eight words of DRU 2's data message, etc.

The SAR instrument data requirements will utilize 120 of the 559 spare words immediately following the 520 TIP data words in the GAC frame (see figure 2-1). The SAR data will begin with the first word following the TIP data, and all SAR data will be contiguous. The first SAR word in any GAC frame will be a 24-bit TBD sync pattern. Thus, 1176 bits will be



Sync Δ - 1 Word
 Space Data - 50 Words
 Back Scan Data - 30 Words
 Telemetry Data - 10 Words
 Time Code - 4 Words
 Identification - 2 Words

Notes:

- 1) Frame Length - 3327 Words
- 2) Frame Rate - 2 Frames/Second
- 3) Word Length - 10 Bits

TLM WORD ALLOCATIONS		ID WORD BIT ALLOCATIONS	
		1st ID WORD	2nd ID WORD
1-5	Ramp Calibration	1 Sync ID	1-10 Spare
6	Channel 3 Target Temp (5pt Subcom)	2-3 Frame ID	
7	Channel 4 Target Temp (5pt Subcom)	4-7 S/C Address	
8	Channel 5 Target Temp (5pt Subcom)	8 Resync Marker	
9	Channel 3 Patch Temp	9-10 Spare	
10	Spare		

* 24-bit sync word plus 49 24-bit data words

Figure 2-1. GAC Frame Format

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Word \ Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	DRU#				Sync Pattern (Hex: DGO)												Received Level							
2					Time Code (Binary x 20 millisecond)																			
3 . . 6					ELT decoded data (20 bits per word) ----- ----- (------)																			
7					ELT decoded data (last 8 bits)										Zero padding									
8					Received frequency measurement; 20 bits																			

Figure 2-2. SAR Processor Data Message Format



available for 49 SAR processor 24-bit words. Since a data message consists of eight 24-bit words, it is possible to have a data message split among two GAC frames. A data message can also be split among two GAC frames because there may be interleaving of the words of different DRU's when there are multiple data messages.

All SAR incident data will be input into GAC and none will go into TIP. All SAR housekeeping/status data will go into TIP and none will go into the SAR portion of the GAC frame.

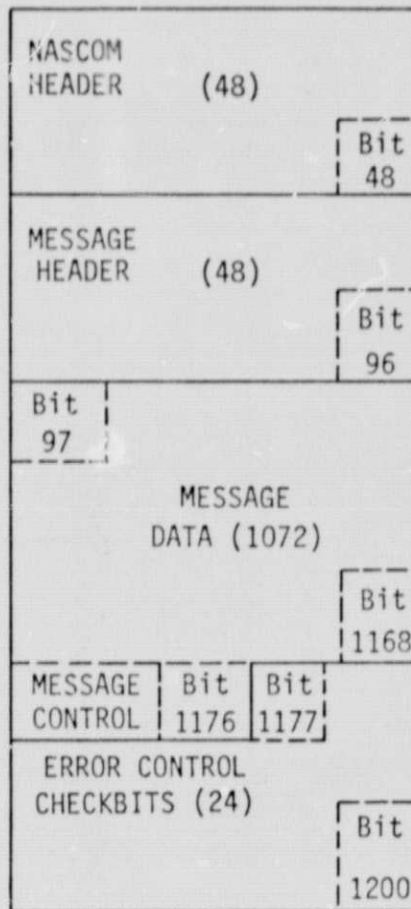
SAR incident data will be stripped out of the MIRP format in the same sequence as generated (i.e., not reversed) and reformatted for transmission to the USMCC. These data should be available for transmission to the USMCC within twenty minutes after data is received at Suitland.

The SAR data will be formatted at DPSS into NASCOM 1200-bit blocks (see figure 2-3). Further information describing fields in the NASCOM blocks and the NASCOM protocol as utilized by DPSS is found in reference 3. The SAR instrument data will be inserted into the available 1072-bit data field of each NASCOM block, beginning with the first bit of the data field, in contiguous increments of one SAR data word. (Each SAR data word is 24 bits.) No SAR data word will be split among two NASCOM blocks. Thus, the data field of a NASCOM block will contain from 1 to 24 SAR data words.

When no data are available for the data flow, "non-significant" all zero 24-bit words will be output from the SAR 406 processor. DPSS will therefore only put non-zero data words into NASCOM blocks for transmission to the USMCC.

The Doppler differences in the SAR incident data will only yield the distance from the spacecraft to the ELT/EPIRB. In order to determine the position of the ELT/EPIRB, the time that the SAR instrument received

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The basic format for all message types is the same. Only the message data part varies.

Figure 2-3. Basic NASCOM Block Format



the transmission is required because the spacecraft ephemeris is a function of time. Time is required to be accurate to at least 0.1 sec, which represents about 740 meters of the spacecraft's orbit. Time must either be input into the SAR data messages or furnished by some other means, such as the following possibility: referring to figure 2-1, it is seen that each GAC frame contains a four-word (40 bits) time code referenced to the first bit of data in the GAC frame. If this time code can be interpolated to each SAR data message within the 0.1 sec accuracy constraint, then it would not be required to insert time into the SAR incident messages itself. Note that there is a time code in the processor data message (see figure 2-2). This time code is a time counter which resets to zero about every $2\frac{1}{2}$ hours. (A 5-hour count is actually available if one considers the most significant bit of the time code, which is in TIP.) It is possible that future 406 processors will have their own 2.4 kbps clock and 0.5 second frame pulse which will constitute a spare in case of MIRP failure.

Since, at most, 30% of the 406 data will be non-zero (probably 10% is a better estimate), it is felt that a 7.2 kbps line will be adequate. This must be a full-duplex line because of the acknowledgement protocols required for block transmission. SAR data will be output to the DPSS/USMCC modem at a rate consistent with the 7.2 kbps rate minus the NASCOM block overhead.

SAR incident data will be retained until successful receipt at the USMCC. The SAR data of a given orbit will be transmitted to the USMCC in a time incrementing fashion. If there are data for more than one orbit to be sent the USMCC, then the data from the latest orbit will be transmitted first.

The USMCC will use the dumped incident data to calculate the location of distress signals. Upon doing so, it will notify the appropriate RCC or agency (via teletype). Note that the LUT's have no use for the dumped data.



Canada also requires the dumped incident data for position location. The Canadian MCC will receive these data directly from the USMCC.

2.2 EPOCHERIS DATA

Ephemeris data for the TIROS-N spacecraft is required by the LUT's in order to (1) compute the location of the repeated ELT/EPIRB signals, and (2) point the antenna. Ephemeris requirements for the latter function are much less stringent than for the former. Ephemeris data is also required for the position location algorithms associated with the 406 processed tape recorded (and dumped) data.

In order to maximize the position location accuracy, the required ephemeris should be as accurate as possible. The minimum accuracy requirement over three days is:

- 3 kilometers along-track error
- 300 meters radial error
- 500 meters cross track error.

Ephemeris data will be in earth fixed coordinates and consist of the following:

X, Y, Z	position
$\dot{X}, \dot{Y}, \dot{Z}$	velocity
T	time

The quantities $X, Y, Z, \dot{X}, \dot{Y}, \dot{Z}$, and T are double precision (64-bit) quantities.

It is assumed that ephemeris data will be transmitted once per day from NOAA's DPSS to the USMCC. From there it will be sent to Canada. (The initial orbital elements are supplied to NOAA by NORAD.) The ephemeris which is transmitted each day will consist of three day's worth of predicted ephemeris expressed as minute vectors, i.e., 3 days x 24 hr/day



x 60 min/hr = 4320 vectors (including time and other TBD parameters). The position location software interpolates the ephemeris to the exact time required.

The 3 kilometer along-track error previously mentioned represents the worse case after three days. The decay of predicted ephemeris accuracy is non-linear, with the rate of error increasing with time. The first few minute vectors of the transmitted ephemeris data will have an along-track error of about 300 meters, and it is assumed that the first days of the predicted ephemeris will have an along-track error of 1 kilometer at most. Thus, if NOAA transmits ephemeris data once per day, the SAR mission will always have an ephemeris with an along-track error of 1 kilometer at most.

If NOAA is unable to supply an ephemeris with the accuracy required by the SAR mission, then there are two options available: (1) the SAR mission could obtain the NORAD orbital elements and propagate its own ephemeris; and (2) the SAR mission could update the NOAA-supplied ephemeris by using fixed earth beacons transmitting at 406 MHz.

Ephemeris data will be transmitted from DPSS to the USMCC in NASCOM blocks over the same 7.2 kbps full duplex line that is required for transmitting SAR incident (section 2.1) and SAR instrument telemetry (section 2.3) data. Since the USMCC will compute position locations for the 406 processed tape recorded data, it will require all the ephemeris because it is not known a priori where an incident occurred. On the other hand, since the LUT's have a real-time mode of operation, they require ephemeris data for only those times that they are in the spacecraft's field of view. Therefore, USMCC will transmit to the LUT's only the ephemeris that they need. Since this represents about 60 minutes' worth of ephemeris data per spacecraft per LUT per day, transmission via teletype or another commercial line should prove adequate.



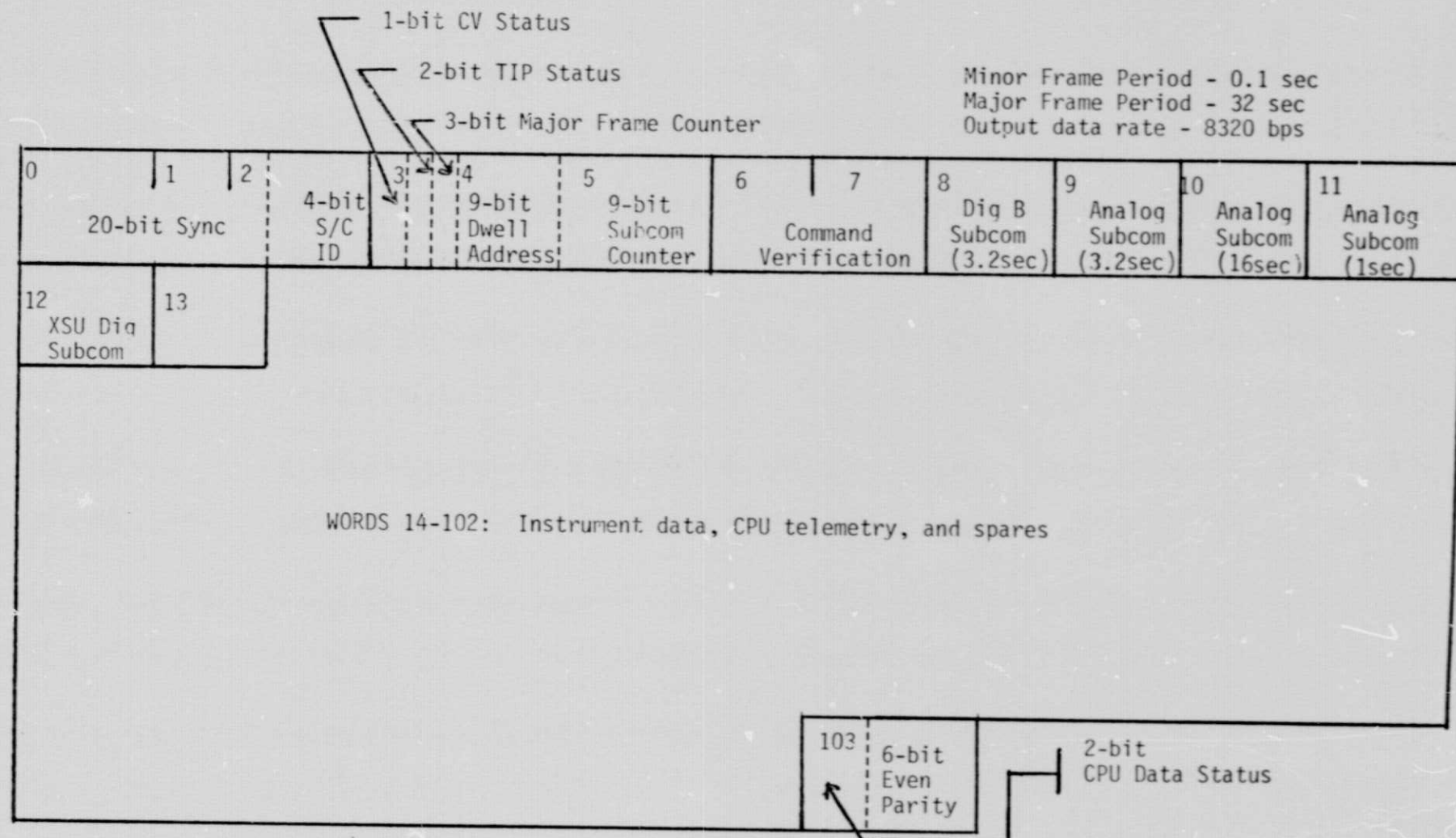
Since the Canadians are processing recorded SAR incident data, they also require all ephemeris data. All ephemeris data received by the U.S. MCC will be forwarded to Canada.

2.3 SAR INSTRUMENT HOUSEKEEPING/STATUS DATA

The SAR on-board instrument, which consists of a Canadian repeater and a French 406 Processor, will input housekeeping/status telemetry data into TIP. There are 104 eight-bit words in a TIP minor frame (see figure 2-4). There are 320 minor frames in a major frame and there is a new minor frame each 0.1 sec. SAR instrument housekeeping/status telemetry is dispersed in the stored TIP data frame in words 4, 5, 8, 9, 10, 11, 12, and 13. Upon receiving an analysis from NOAA, the SAR mission will determine which of the following options will be selected to send SAR instrument housekeeping data to the USMCC:

- a. Option 1. For each TIP frame that is in GAC (see figure 2-1), all words 4, 5, 8, 9, 10, 11, 12, and 13 are stripped, reformatted, and sent to the USMCC.
- b. Option 2. Only the particular words from each TIP/GAC frame which contain SAR instrument housekeeping data and TBD spacecraft parameters that are required for health and trends, are stripped, reformatted, and sent to the USMCC. The SAR instrument telemetry distribution in TIP is TBD.
- c. Option 3. Only the particular bits from each TIP/GAC frame which are SAR instrument housekeeping or required TBD spacecraft parameters are stripped, reformatted, and sent to the USMCC.

The total SAR instrument, i.e., the Canadian repeater and French processor, requirements are estimated as 45 Dig B and 45 analog telemetry points.



Notes: Number in upper left-hand corner indicates Minor Frame word number.
 Time Code Data will appear during Minor Frame "0" word locations 8 through 12.
 Char A is first byte of 24-bit word. Each byte is aligned such that three 24-bit words appear/frame.
 *The subcommutation function is accomplished in the XSU.

Figure 2-4. TIP Orbital Mode Minor Frame Format



When the TIROS spacecraft is over a TIROS ground station, real-time down-linked TIP data (about 10 minutes' worth) will be decommutated, limit checked, and monitored at SOCC for spacecraft health and safety use, and instrument health, safety, and command verification. No SAR telemetry in real-time TIP is required to be sent to the USMCC.

The SOCC will immediately notify the USMCC of out-of-limit conditions and non-verification of commands. This notification will be via teletype with telephone coordination. Canada's MCC will also be in this loop. The limit range (high fail and low fail) and the command verification bits will be supplied to the SOCC by the SAR project.

The TIP word and frame rate is directly compatible with the GAC word and frame rate; five TIP minor frames are inserted (at 0.1 sec per minor frame) into the GAC frame each 0.5 sec (see figure 2-1). Two parity bits are added to the 8-bit TIP word to form the 10-bit MIRP word. All of the TIP, including the TIP that is downlinked in real-time is recorded in the GAC. Therefore, for complete instrument trend analysis, the SAR telemetry in TIP which becomes part of the GAC frame is required. Since Canada's MCC will be doing repeater trend analysis, it will receive housekeeping data from the USMCC. The Canadian MCC requires that these data be made available to it within two hours after they are downlinked. The mechanism for forwarding housekeeping data to the French for processor health and trend analysis is TBD.

2.4 COMMANDS

The SAR instrument command requirements are:

Canadian Repeater	6 pulse discrete and 36 level discrete commands
French Processor	<u>12</u> pulse discrete commands
INSTRUMENT TOTAL	18 pulse discrete + 36 level discrete = 54 commands



All commands and command lists will be resident in SOCC, which will receive command requests only from the USMCC. These command requests will be sent via teletype with telephone coordination; requests will be referenced to the command list resident in SOCC by acronym and/or numerics.

Command sequences will be compiled using information furnished by the Canadian MCC, the LUT's and France. Command sequences will be transmitted to SOCC only after close teletype/telephone coordination between the USMCC and Canadian MCC. One command sequence of about ten commands per day transmitted one day in advance is the estimated command requirement during a spacecraft's activation phase; the operational phase is anticipated to require one command sequence of 20 commands per week/spacecraft. There are no critical commands that affect the health and safety of the spacecraft and no real time commands are anticipated except for a possible emergency. A safe condition command sequence will be supplied to SOCC.

As stated in section 2.3, the SOCC will decommutate, limit check, and monitor TIP data for command verification. The USMCC will be immediately notified by SOCC of any failed condition, and the USMCC, in turn, will immediately notify and consult with Canada.

2.5 SCHEDULES AND SCHEDULE CONFLICTS

Any schedule conflicts and readjustments, e.g., due to emergencies, conflicts within SOCC or DPSS schedulers, rescheduling due to line outages, etc., will be interactively resolved via teletype/telephone with the USMCC, which will be the single point of communications to NOAA for normal operations.



2.6 ACQUISITION SCHEDULES

Since DPSS will have schedules of when the TIROS-N spacecraft is within the Field of View (FOV) of the TIROS-N ground station, the USMCC and Canada's MCC will want these schedules from DPSS so that they will know when to expect data. Assuming the existence of a 7.2 kbps line between DPSS and the USMCC, the acquisition schedules should be sent over this line, since there does not appear to be a requirement for a USMCC/DPSS teletype link. Note that, alternatively, the USMCC can derive these schedules from the ephemeris.

Additionally, since the USMCC will only distribute to the LUT's the ephemeris that they need, the USMCC must know when TIROS is in the FOV of the LUT's. These acquisition schedules could be furnished by DPSS or derived by the USMCC from the ephemeris.

2.7 SYSTEM EVALUATION

Efforts should soon begin to establish parameters to be used to evaluate the satellite-aided concept. A data base concerning present operations should be accumulated so that by 1981 there will be sufficient data by which to compare the impact of satellite-aided Search and Rescue.

Parameters to be included in this data base may include the following:

- a. Category (aircraft, pleasure boat, etc.).
- b. Type of incident.
- c. Time elapse between distress and time reported (awareness stage).
- d. Time elapse between detection and planning (initial actions state).
- e. Time required for planning stage.
- f. Time elapse between SRU underway and rescue complete (or mission closed), i.e., operational phase.
- g. Time required for mission conclusion.
- h. If aircraft, was flight plan filed? If so, what type?



- i. Geographic data.
 - (1) Terrain.
 - (2) Country.
 - (3) State.
 - (4) Subregion
- j. Last known coordinates.
- k. Light and climate conditions.
- l. Locating agency.
- m. Distressed personnel data.
 - (1) Number involved.
 - (2) Number located.
 - (3) Total recovered/assisted.
 - (4) Numbers recovered injured.
 - (5) Died enroute.
 - (6) Total number dead.
 - (7) Total number missing.
 - (8) Total number saved.
- n. Exact coordinates of recovery/wreckage.
- o. Methods of detections of final location.
- p. Resources used.
 - (1) Personnel.
 - (a) Civilian.
 - (b) Government.
 - (c) Time expended.
 - (2) Number and type of aircraft used.
 - (3) Number and type of aircraft lost.
 - (4) Hardware/supplies used.
- q. Was ELT/EPIRB involved?
 - (1) Was awareness of distress by ELT/EPIRB?
 - (2) Was ELT/EPIRB helpful in final location?
 - (3) Was ELT/EPIRB operational during distress?



r. Quantitative ELT/EPRIB information.

- (1) Number of ELT/EPIRB incidents.
- (2) Number of "real" ELT/EPIRB incidents, i.e., relating to a distress condition.

In the United States, the primary agencies for gathering this type of information are the U.S. Air Force and U.S. Coast Guard. It is assumed that these agencies, as well as the Canadian MCC, will add to and modify the preceding list, they will also begin to compile a data base of the data in the list that is relevant to their respective Search and Rescue charters.

2.8 LUT COORDINATION

It is a design goal that the LUT's be almost identical and be self-sufficient. During the Demonstration Phase, however, the LUT's will be manned, and there will be coordination between them and with the MCC's.

There is differing opinion on how much the LUT's will have to be programmed when the SAR instrument is first launched. The amount of such reprogramming will strongly depend on the amount of system simulation there will be before launch. If the system is properly exercised before launch, the amount of reprogramming will be minimal. In any case, in order to ensure uniformity of software in the LUT's, the MCC's will assume the coordination responsibility for software updates.

As a system "self-test", the MCC's can compare their position locations of 406 MHz ELT/EPIRB's with those obtained by the LUT's. Note that when there is mutual spacecraft visibility by an ELT/EPIRB and LUT, the processed 406 data will be downlinked to the LUT as well as tape recorded. Note also that there will be cases when tape recorders will provide 406 position location faster than the bent-pipe system. This can happen, for



example, on an overflight where each of two LUT's receives less than three minutes of bent-pipe 406 data and, therefore, neither has enough information to calculate position.

2.9 MISSION COORDINATION

All coordination of satellite-aided Search and Rescue will be the joint responsibility of the U.S. and Canadian MCC's.



SECTION 3. MISSION CONTROL FUNCTION REQUIREMENTS



SECTION 3. MISSION CONTROL FUNCTION REQUIREMENTS

This section is a summary of the interface requirements necessary to perform the mission control functions. These requirements are given in table 3-1. Figure 3-1 gives an overview of the SAR mission data flow.

Table 3-1. U.S. SAR Mission Control Center Functions and Their Data Requirements

FUNCTION	REFERENCE	INTERFACE	COMMUNICATIONS LINK
Receive and process 406 MHz stored data	Section 2.1	NOAA/DPSS + USMCC USMCC + Canada MCC	7.2 kbps full duplex TBD
Forward position locations based upon stored 406 MHz data to appropriate RCC's	Section 2.1	USMCC + RCC's USMCC ↔ Canada MCC (for self test) USMCC ↔ LUT's (self test and data base)	Teletype/telephone Teletype/telephone Teletype/telephone
Receive and distribute ephemeris data	Section 2.2	NOAA/DPSS + USMCC USMCC + Canada MCC USMCC + LUT's	7.2 kbps full duplex TBD Teletype or other commercial
Receive recorded TIP data relative to the SAR instrument	Section 2.3	NOAA/DPSS + USMCC NOAA/DPSS + Canada MCC or USMCC + Canada MCC TBD + France	7.2 kbps full duplex TBD TBD
Single point of contact for communications to NOAA (commands, emergencies, resolution of schedule conflicts, etc.)	Section 2.4 Section 2.5	USMCC ↔ Canada MCC USMCC ↔ LUT's USMCC + SOCC USMCC + DPSS	Teletype/telephone Teletype/telephone Teletype/telephone Teletype/telephone
Receive and forward acquisition schedules	Section 2.6	NOAA/DPSS + USMCC (or can get from ephemeris) USMCC + LUT's USMCC + Canada MCC (if desired)	7.2 kbps full duplex Teletype Teletype

Table 3-1. U.S. SAR Mission Control Center Functions and their Data Requirements (cont.)

FUNCTION	REFERENCE	INTERFACE	COMMUNICATIONS LINK
Collect data base for system evaluation	Section 2.7	USMCC ↔ Canada MCC Canada MCC ↔ DND USMCC ↔ U.S. Coast Guard USMCC ↔ U.S. Air Force	Telephone Telephone Telephone Telephone
Coordination among LUT's (e.g., software development)	Section 2.8	USMCC ↔ Canada MCC USMCC ↔ LUT's	Teletype/telephone Teletype/telephone
General coordination of satellite-aided Search and Rescue	Section 2.9	USMCC ↔ Canada MCC	Teletype/telephone

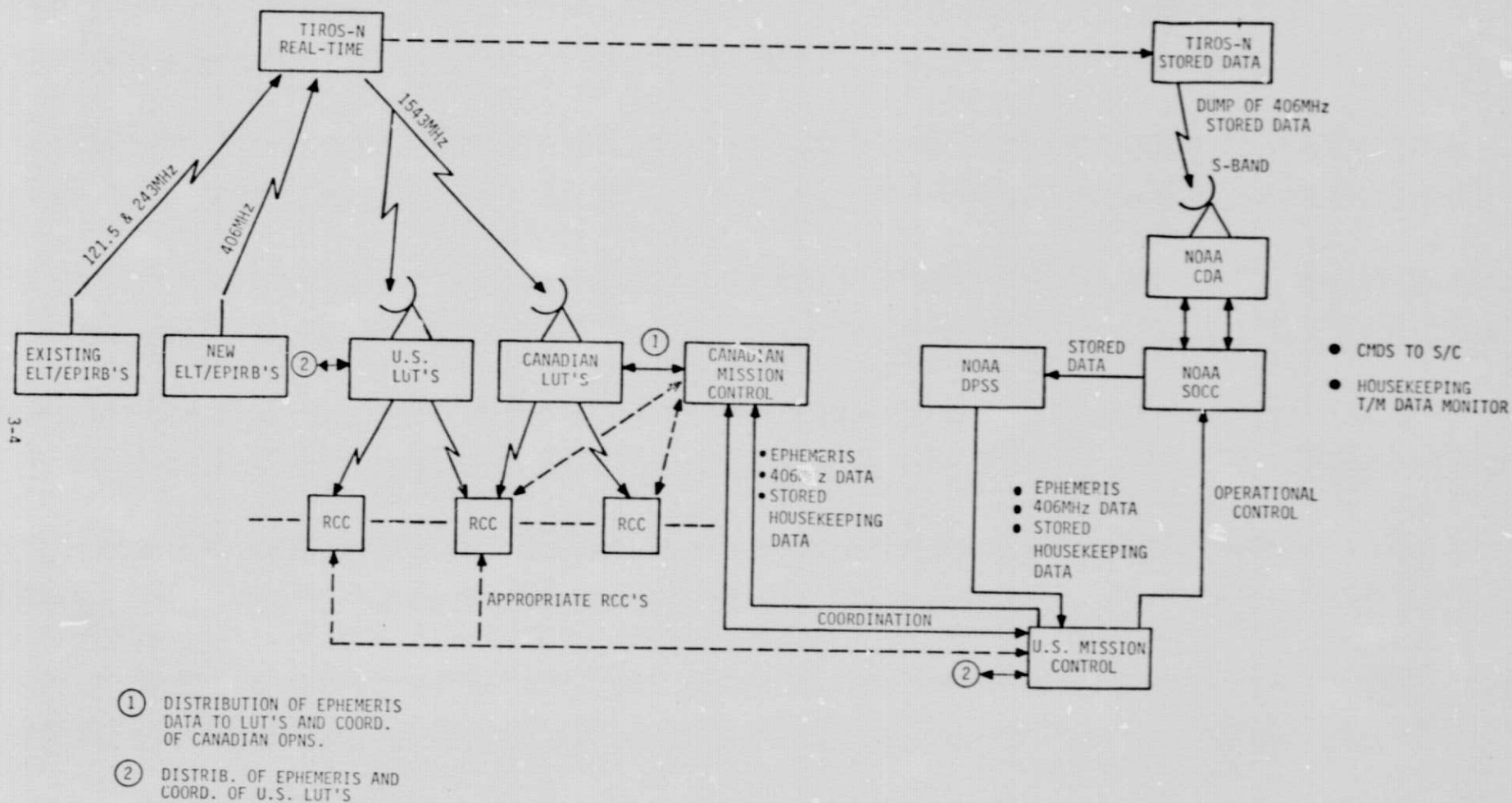


Figure 3-1. SAR Mission Data Flow for Normal Operations



SECTION 4. MISSION CONTROL INTERFACE REQUIREMENTS



SECTION 4. MISSION CONTROL INTERFACE REQUIREMENTS

A summary of the functional data requirements between the U.S. Mission Control Center and each of its interfaces is given in table 4-1.

Table 4-1. Mission Control Interface Requirements

INTERFACE	DATA DESCRIPTION	DATA FLOW *
NOAA/DPSS	SAR incident data stripped from GAC Ephemeris data Instrument TIP telemetry data Acquisition schedules Schedules and schedule conflicts	← ← ← ← ↔
NOAA/SOCC	Instrument commands Emergencies Schedules and schedule conflicts	→ → ↔
RCC's	Position location Data base information	→ ←
LUT's	Ephemeris Acquisition schedules Position locations (for data base) Software update uniformity	→ → ↔ ↔
U.S. Coast Guard	Coordination and data base	↔
U.S. Air Force	Coordination and data base	↔
Canadian MCC	All coordination Ephemeris data SAR incident data stripped from GAC Instrument TIP telemetry data Acquisition Schedules Data base	↔ → → → → ↔

* An arrow pointing to the right denotes data flow from the USMCC; an arrow to the left, data flow to the USMCC.



SECTION 5. U.S. MISSION CONTROL CENTER



SECTION 5. U.S. MISSION CONTROL CENTER

This section suggests possible alternatives for locating the U.S. Mission Control Center in the SAR system. In broad terms, the USMCC is responsible for: (1) distributing information (ephemeris, 406 MHz stored data, and SAR instrument TIP data); (2) calculating distress positions based upon stored 406 MHz data; (3) serving as the single point of contact for communications to NOAA; and (4) coordinating, with Canada, the satellite-aided SAR mission. Note that the first two broad functions require a computing facility. Additional USMCC functions that require a computing facility include the following: strip/format telemetry data, assembly of a SAR mission data base, ephemeris processing, spacecraft and LUT scheduling, display/console support, and reporting formats. These computing functions are baselined for two concurrently operational SAR instruments.

An appealing solution for the USMCC could be to colocate it with an LUT. This has the important advantage that the USMCC could use an LUT's computing facility. The net result would be that the USMCC could be manned by a single person with a teletype and telephone. It is assumed that the manning would be a joint U.S. Air Force/Coast Guard responsibility. In order for the USMCC to share an LUT's computing facility, the SAR mission would require that the facility not be overloaded and that the LUT's operations not be impacted. To assure these conditions, the LUT in question would be provided with a more powerful computing facility than the other LUT's. This is feasible only when all LUT's will be provided with members of a compatible computer family. The reason for this is the requirement for software compatibility.



Another alternative would be for the U.S. Mission Control Center room to be colocated with one of the large RCC's (such as Scott AFB or Governors Island) and for the USMCC to use a large existing Air Force or Coast Guard computing facility. The cost effectiveness of this alternative should be carefully studied and weighed against some of the disadvantages. One disadvantage is that the large computer facilities are not normally geared to a "real-time" mode for operation. The computing facility would have to accept 406 data when available, expeditiously compute locations, transfer 406 data immediately to Canada, transfer instrument TIP data to Canada within two hours, etc. SAR entry into the computing facility would be by remote control. Another disadvantage is an interface problem. Would data go from Suitland directly to the computing facility or would it go from Suitland to the USMCC, and from there be switched to the computing facility?

The final alternative would be for the USMCC to have its own computing facility. If this were the case, then that computer should be compatible with the LUT computers in order to use the position location software developed for the LUT's.

In summary, there are viable alternatives for locating the USMCC, but further explorations between the SAR project, the Air Force, and the Coast Guard are needed.



REFERENCES

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GLOSSARY

CRC	Communications Research Center (Ottawa, Canada)
DND	Department of National Defense (Canada)
DPSS	Data Processing and Services Subsystem
DRU	Data Recovery Unit
ELT	Emergency Locator Transmitter
EPIRB	Emergency Position Indicating Radio Beacon
GAC	Global Area Coverage
LUT	Local User Terminal
MCC	Mission Control Center
MIRP	Manipulated Information Rate Processor
NESS	National Environmental Satellite Service
NOAA	National Oceanic and Atmospheric Administration
RCC	Rescue Coordination Center
SAR	Search and Rescue
S OCC	Spacecraft Operations Control Center
SRU	Search and Rescue Unit
TIP	TIROS Information Processor
USMCC	United States MCC (for Search and Rescue)